Software Modification to the Traceability and Reporting System

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The Traceability and Reporting System (TRS) is a Network Information Control function that stores, maintains, and reports on data collected during each tracking period. This article explains the TRS, the improvements made on the software, and the reasons for the software modifications.

I. Introduction

The Network Information Control (NIC) function is organized as part of the Network Operations Control Group and supports the DSN by:

(1) Providing an effective index to all information concerning station tracking periods for each mission

(2) Providing quick-look information concerning station tracking periods for each mission

(3) Supplying monthly operations summaries of selected data to DSN management

(4) Maintaining data bases capable of providing special reports as required by management

(5) Providing coordination for shipment of all DSN data records

This article provides an explanation for the Traceability and Reporting System (TRS).

II. Traceability and Supporting System

The function of the TRS is to provide investigators, analysts, and end users with information which has been collected by the Network Operations Group. To accomplish this task, three files are maintained for data storage and report generation. One file is stored on microfilm and contains passfolder information. Passfolders contain all the DSN data logs, summaries, and other information gathered and compiled by the Operations Support Analysts concerning a single Deep Space Station (DSS) spacecraft tracking period. The other two files are stored on magnetic tape from the IBM 360/75 computer system. The first of these two computer-processed data bases contains index information leading to the location of specific passfolder information contained in the microfilm file. The other data base contains passfolder summary information. This summary data consists of information that is most desired by users for analytic and decision-making purposes and is readily available for the generation of monthly reports and special requests.

Both the passfolder and the summary input form (Fig. 1) are prepared by the Realtime Network Operations Analysts and forwarded to NIC at the end of each tracking pass. On receipt of those materials NIC then initializes the DSN Operational Data Control (ODC) input-index form (Fig. 2). A passfolder key is then assigned and recorded on the input-index and summary forms, and the transaction is recorded in the passfolder log. The passfolder log serves as a referral to any passfolders that have been forwarded to the microfilm lab. After posting has been made in the log, the passfolder is sent out for microfilming, while the summary keypunch sheet is keypunched and entered to the summary data base. The microfilm lab enters the roll and frame numbers on the DSN Operational Data Control input-index form that is filmed along with each passfolder. Once filmed, passfolders are returned to NIC where the microfilm is stored, and each passfolder roll and frame number is posted to its corresponding entry in the passfolder log. The ODC input-index form is then keypunched to data cards, which are entered to the index data base. Passfolders are then returned to the Network Operations Analysts for post-pass and nonreal-time analysis.

The purpose of the TRS is to provide users with valid and timely data for analytic and decision making functions. The interaction between the microfilm and computer data bases is designed to accomplish this goal while maintaining a satisfactory level of cost. To insure that users receive accurate data (reports) a system that provides for continuous data validation through the TRS has been developed. The validations system begins as the passfolder first arrives in NIC where it is checked for completeness. Any passfolder or summary that does not contain all the required information is returned to the Operations Support Analysts for completion. NIC does not attempt to interpret data, but familiarity raises questions on entries that do not appear consistent with past data. Data are again verified as they are input to each of the computer data bases. This checking is performed by the software that does the file updating. The software checks all constants and variables that have a fixed number of entries for consistency, it also confirms that all the data have been entered. All records not meeting these validity constraints will be rejected and printed in an error report. Corrections can then be made by referring to the microfilmed passfolder records or the Operations Support Analysts. All input cards are listed and checked visually for keypunch errors. The final check entails comparing the index and summary data bases to confirm that all records have been entered correctly. This is accom-

plished each month by software that reports all discrepancies that may exist.

III. File Management

In designing an effective computer file from which users can draw meaningful information, the file originator must first establish and understand all user requirements. Without this initial groundwork the tendency is usually to have created a file which contains too many or not enough data. An information system that contains a great deal more data than are necessary for its users can create problems that lead not only to added expense but also to decreasing the reporting accuracy of the system. The former summary data base serves as an excellent example of these problems. Previously, all information that was stored on microfilm from the DSN Network Analysis Area (NAA) Composite Pass Summary Report (Fig. 1) was also stored in the summary file. It had been brought to NIC's attention that the monthly Operations Report which was produced from this file contained far too many errors to be considered acceptable. Corrections needed for this report required several days at great expense in man hours and computer runs to produce an acceptable report. A study to determine the major causes of these errors concluded that the size and format of the Composite Summary Report made it difficult to keypunch and verify the input data. To correct the problem it was first necessary to establish the requirements for the summary. This was accomplished by soliciting user response. Once determined, a new file was designed that included only that information necessary for user satisfaction. Next it was necessary to design an input format which would facilitate keypunching and verification routines. This was accomplished by initializing a multi-card data input record (Fig. 2) that not only speeds and aids the keypunching function but also provides a card listing that is easily verified for content by a manual scan of the data. Since this new file was created, report errors have decreased and have continued to decrease to an acceptable level. Time and cost savings have been reflected in a 2/3 decrease for input keypunching and verification as well as a 50% decrease for file maintenance and reporting.

IV. Software

The NIC data bases are maintained by the Mark IV File Management System. It has been our experience that Mark IV is one of the best systems for manipulating files and does so in an efficient and economical manner. The Mark IV software allows the user to create, delete, and

alter records as required. Both the index and summary file maintenance software feature editing routines which verify, correct, or reject each parameter of a record transaction. Mark IV allows the user to obtain a report on desired information in the same computer run for which a file is being updated. Reports generated for use by NIC which do not require a formal output format are handled adequately by Mark IV. Conversely, special reports generated for requestors requiring specific formats have been not only difficult to obtain with Mark IV but also costly.

One example was encountered while attempting to produce the DSN Monthly Operations Report, which requires a special format that is later microfilmed and published in the DSN Operations Report. In this case, it was discovered that the Mark IV system residing in the IBM 360/75 computer did not contain a large enough buffer capacity to produce the required format. The best alternative software for outputting to this format proved to be through the use of the PL1 language which is an excellent report generator from the standpoint of efficiency as well as cost.

Another example reflecting the cost savings accrued by using an alternative program language occurred when it was felt that the Mark IV request that compared the index and summary data bases for consistency was too costly and did not give enough information to satisfy NIC. Comparing data fields from separate files through the use of the Mark IV coordinated file feature required too great a tradeoff between obtaining the greatest amount of information with the least cost. This meant that to get the required data resulted in a sizeable increase in cost, and conversely, decreased cost meant decreasing desired output. The problem was solved by generating a Fortran language program that gives all the needed information and results in a cost reduction of approximately 90% over the previously used Mark IV software.

V. Conclusion

NIC's experience with software has been that familiarity with more than one type of program language has resulted in the necessary flexibility required to meet its objectives.

Fig. 1. Summary input form

MSN-SPC: _____   DOY: _____   DSS: _____   PASS/DATA DAY: _____   BLK TIME: _____   ODC MSN KEY: _____

CONFIG: DSS: _____   COUNTDOWN: _____   AOS: _____   SCHED: _____ Z   LOS: _____ Z   SCHED: _____   TOTAL: _____ H _____ M
          GCF: _____   CLASS: _____   ACTUAL: _____ Z   ACTUAL: _____ Z   ACTUAL: _____ H _____ M
          CPS: _____   START D/XFR: _____   DSS RELEASE: _____ Z   DSS TIME: _____ H _____ M

I COMMAND:

    a. TOTAL COMMANDS TRANSMITTED: _____

☐ *   b. CMDS XMIT AUTO: _____   c. CMDS XMIT MAN: _____   d. CMDS ABORTED: _____

II TELEMETRY:

    a. PWR: _____ kW   PRED: _____ kW   b. BIT RATE: _____ bps   ☐ CODED   c. GOE ☐   MMT ☐

☐ *   d. Rx   AGC: _____   e. Rx   AGC: _____   f. TCP _____   SNR: _____   g. TCP _____   SNR: _____

    ACTUAL: - _____ dBm   - _____ dBm

    PREDICTED: - _____ dBm   - _____ dBm

    DIFFERENCE: _____ dB   _____ dB

III TRACKING:

☐ *   a. TRACKING MODE: 1- 2- 3-WAY   b. RANGING: ☐ NONE ☐ MK IA   ☐ MU ☐ TAU

    c. DOPPLER: CHAR BIAS: _____   CHAR NOISE: _____ Hz   CHAR BIAS _____ RU   CHAR NOISE: _____ RU

    CHAR NOISE: _____ Hz   EXP NOISE: _____ Hz

IV MONITOR:

☐ *   a. DIS: _____   LGWR _____   LGER _____   BLRC _____   BLER _____

    b. TCP _____

FAILURES/ANOMALIES AFFECTING SCHEDULED SUPPORT OF MISSION

  3. EFFECT   4. CORRECTIVE ACTION   5. DR/TFR NUMBERS   6. REMARKS   1. TIME OF OUTAGE   2. PROBLEM

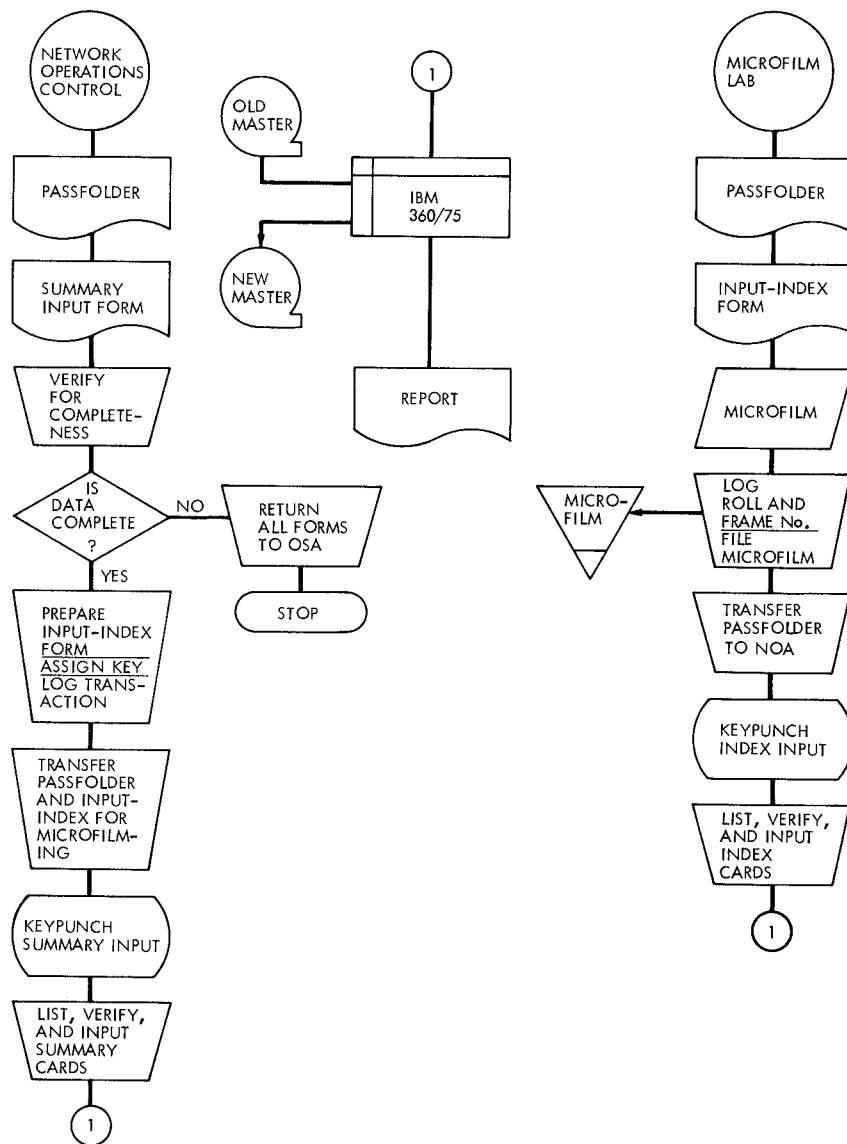**Fig. 2. Composite pass summary report**
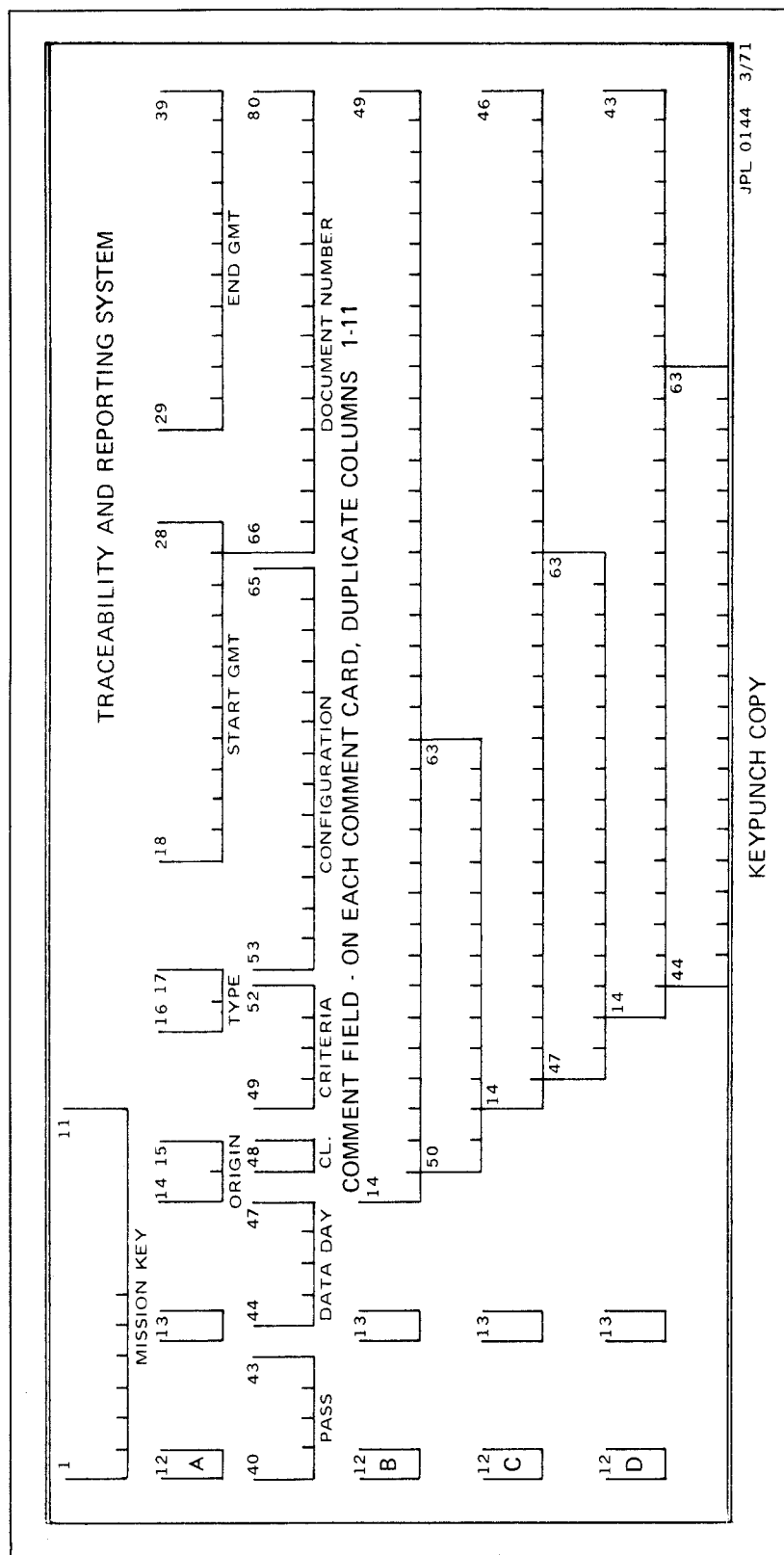
Fig. 3. DSN operational data control input index

Fig. 4. TRS systems report